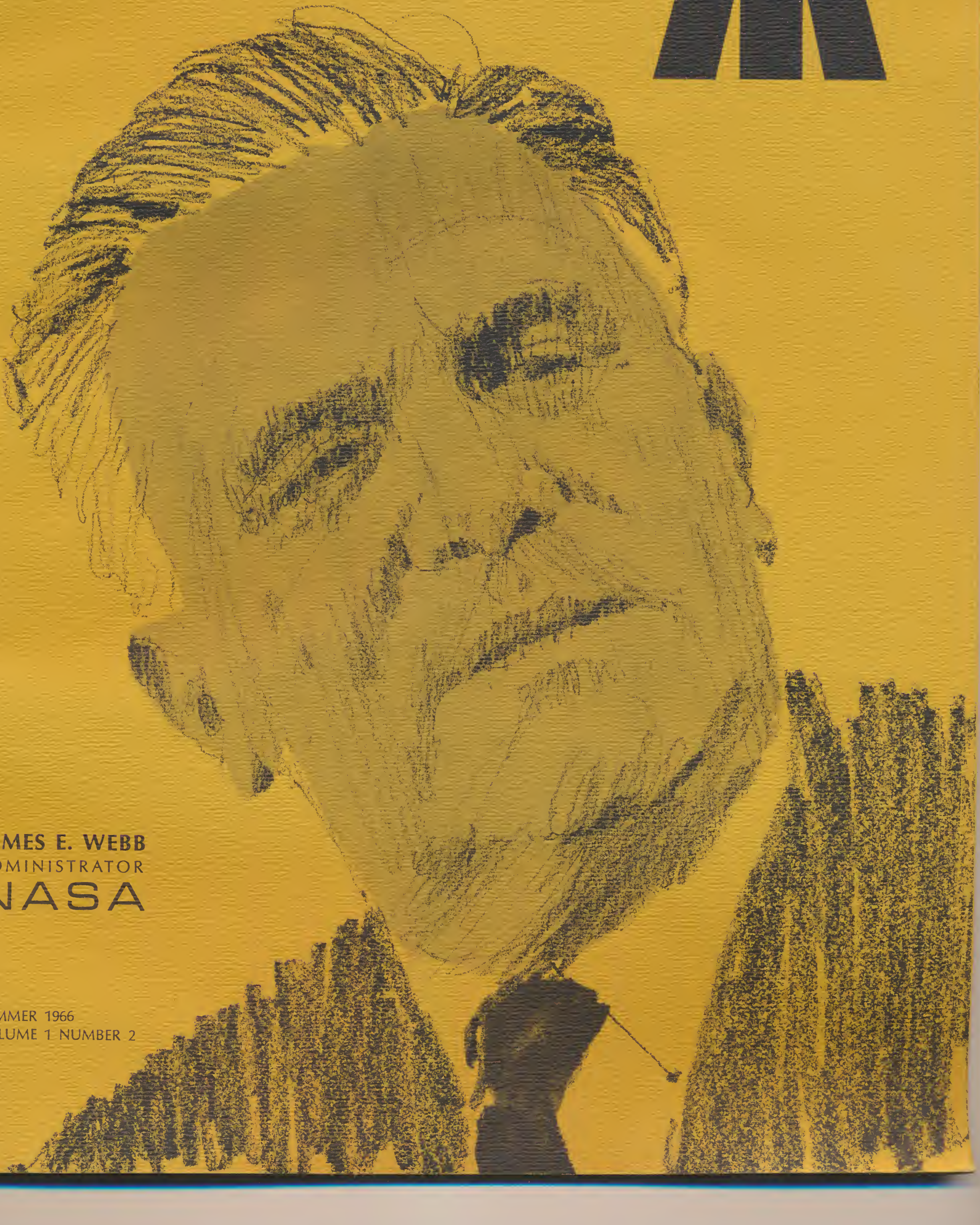
AEROSPACE MANAGEMENT

GENERAL ELECTRIC COMPANY ☐ MISSILE AND SPACE DIVISION



JAMES E. WEBB
ADMINISTRATOR
NASA

SUMMER 1966
VOLUME 1 NUMBER 2

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FEATURES PAGE

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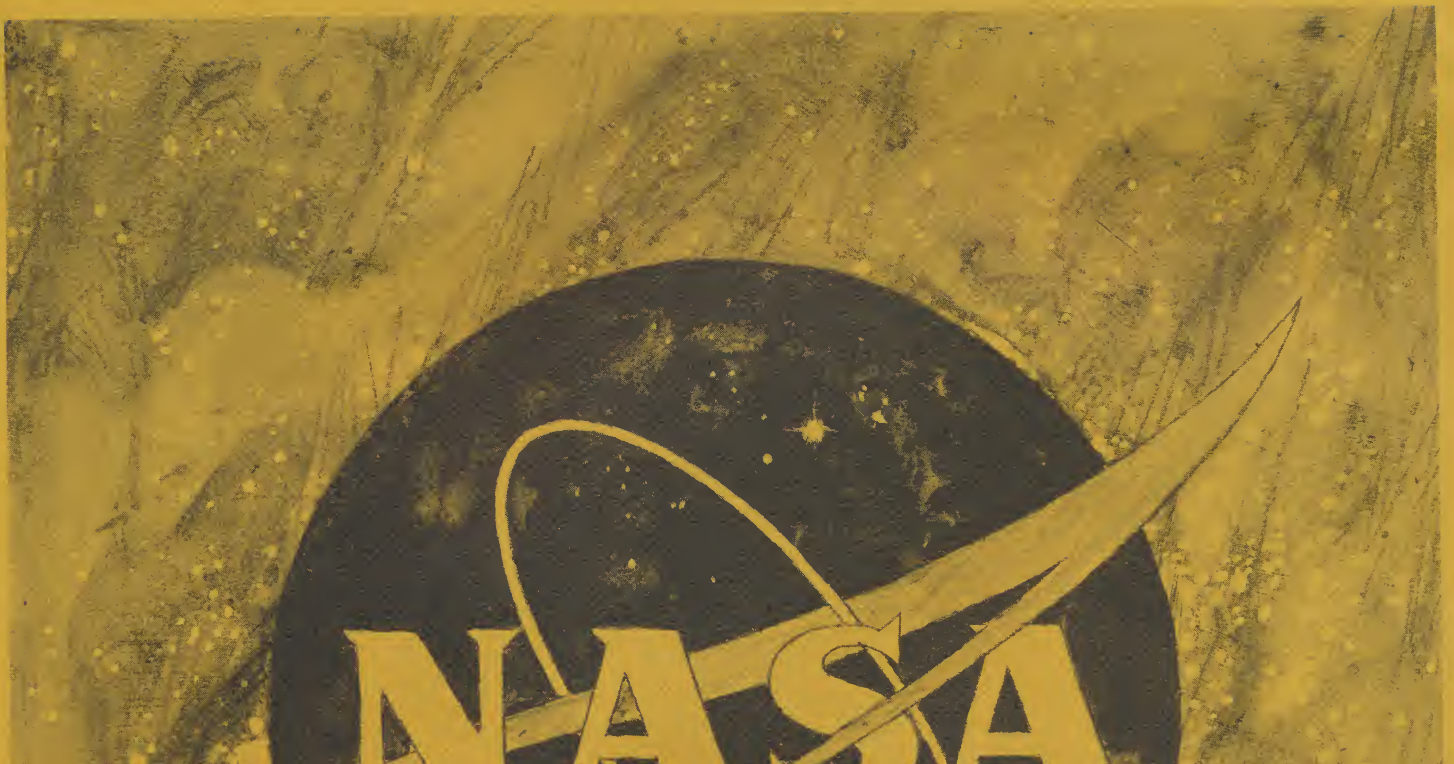

NASA

NASA MANAGEMENT AT THE CROSSROADS

By S. Peter Kaprielyan

Top team scans spectrum of management challenges, Culls lessons and braces for critical year ahead

Of the countless facets of the U. S. Space Program, none is more interesting, from the vantage point of this publication, than the methods developed and the experience derived from managing an effort of such unprecedented dimensions.

Over $20 billion have been appropriated and spent by NASA during the last five years to build a broad-based space capability. Today the National Aeronautics and Space Administration is engaged in coordinating the efforts of some 20,000 prime and first- and second-tier subcontractors. The managerial challenges of this undertaking and the significance of the methods being used are certainly worth studying. To do this, Aerospace Management will devote a series of articles, each centering on a topic of interest from the customer-contractor vantage point. This first article in the series will attempt to delineate NASA's management challenge as viewed broadly from top echelon.

What unusual varieties of attributes should a public administrator have to be capable of directing the U.S. Space effort?

He should be able to wake up at 4 a.m. shortly after assuming his post, to assure on TV a distraught nation experiencing the shock of a scientific surprise in space.

He should be able to accept the responsibility of building and managing a space capability second to none, then be able to stand on the congressional carpet year after year, to justify over and over the need for extensive and expensive effort.

He should be able to spend five years putting the world's greatest complex of space facilities and manpower into high gear, then be able to face budgetary cuts and the prospects of losing a hard-gained momentum.

Lastly, he should be able to practice his profession in the "glass house" of democracy, in full view of the public and brave its critique.

For five grueling years now Administrator Jim Webb has been operating in the full glare of the world—exposed to a flood of commentary by expert and tyro alike. And the maintenance of a consistent pattern of management with this abundance of commentary from all comers is perhaps what has vexed Webb the most. "Much of the reporting of national efforts that we find in the daily press, in many of the mass media, in matter which impinges on our senses every day, does not give a full and fair presentation or provide a test of values," he says. "Much of it is devoted to things which are either controversial or spectacular. And this is probably more true of the space program than of any other," he adds.

Mission Transcends Men and Events

Ironically enough, the spectacular aspects of the space program have continued to both help and hinder NASA in conveying its mission to the public. The spectacular accomplishments in space have certainly served to capture the Nation's attention, and to retain it—at least for a time. But much to the regret of Jim Webb, most of the attention has been focused on men and events, and very little indeed on NASA's overall mission and the true nature of its challenge.

What concerns the Administrator and his staff of long-range decision-makers the most on this point is the volatile nature of public support based primarily on spectacular feats. During the hearings before the House Committee on Science and Astronautics, earlier this year, Administrator Webb voiced his concern on this matter as follows:

"I think that as Sputnik recedes into the past and as Gagarin recedes into the past, and as we continue to bring down Gemini within a few miles of the aircraft carriers, the easier it all looks. The plain fact is that we are (presently) moving into a much more difficult field, and public opinion here is less valid than the kind of analysis that we give you when you consider the total national interest.

"My own view is that we must do the job and that the public will be glad it was done. . . . There are, of course, people who cannot understand why it takes so much money to operate in space.

"I think it takes time to understand that we are dealing with a completely new thing when we use a rocket engine . . . that has the power of 6,000 Boeing 707's. The public hasn't had time to catch up with that yet. They do know there is something important here and I doubt very much that they would fail to have a reaction if . . . we, in effect, decided to abandon these fields in space to the Russians."

Little Time and Less Money

While undoubtedly it takes time for a public understanding to develop, the two most serious shortages facing NASA in this seventh year of its life are time and money.

After some monumental efforts by the NASA-Industry-University partnership, the U. S. has moved from a slow start to a position of conspicuous prominence in space exploration. Yet, with barely a robot's toe-hold on the Moon, NASA finds itself today standing at the crucial crossroad. For two successive fiscal years the NASA budget has undergone "surgery" and both Jim Webb and his Deputy Administrator Dr. Robert C. Seamans, Jr. strongly feel that another fiscal phlebotomy can seriously impair the health of our space program. Dr. Seamans' feelings on this matter were expressed in Congress earlier this year, in the following terms:

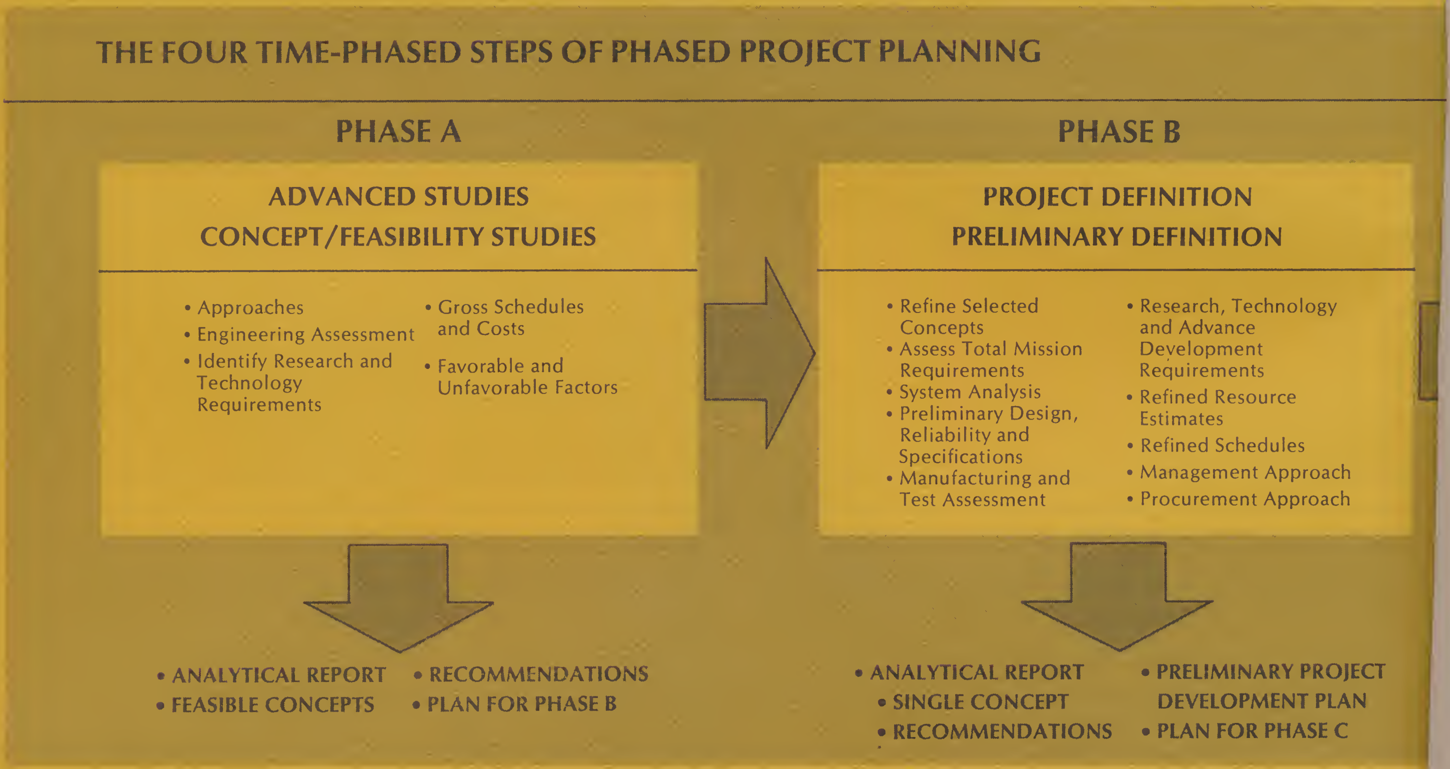
"It is becoming clear that in fiscal year 1968 the Nation must begin to choose among the major options that the NASA program has provided. I believe . . . that in the year ahead, we must identify the major meaningful objectives that will serve as the national focus for the years to come . . . I feel I can say with some assurance

that if such goals are not chosen, then this major and totally new element of national power for creative use, this intricate and successful structure of flight systems, production capability, test and launch facilities, and dedicated men will have to be disassembled, wasting the opportunities for its application to the wider objectives of space exploration. Fiscal year 1967 we see as a period during which we can plan, define, and select; fiscal year 1968 must be the year of choice."

Burden of the Top Team

Since the death of Deputy Administrator Dr. Hugh L. Dryden, last year, the Webb-Seamans management partnership has grown even closer than before. The management functions of this partnership have been consolidated into a single office—the Office of the Administrator where Dr. Seamans serves both as general manager of NASA and as Acting Administrator in the absence of Administrator Webb. This partnership relies on a single central staff in activities which require a NASA-wide overview on public affairs, international affairs, and general administration. In such matters, this same staff also serves the four Associate Administrators who manage the program offices: George E. Mueller, Office of Manned Space Flight; Homer E. Newell, Office of Space Science & Application; Mac C. Adams, Office of Advanced Research & Technology; and Edmond C. Buckley, Office of Tracking & Data Acquisition. Next to Jim Webb and Bob Seamans, these four Associate Administrators bear the heaviest burden of solving NASA's central management problems.

If the great procession of scientific and technological achievements in space are any proof, the majority of NASA's central management problems are being handled with deftness and dedication. The fact is, however, that the very nature of NASA's mission is exploratory and experimental, and confronted by challenges that often lie beyond the frontiers of human knowledge and experience. As such, NASA's top management is first to acknowledge that some of the best lessons learned are taught by practice, rather than theory; and where unprecedented action is the rule, the risks of error are ever present.



Management Lessons Learned

As the other partner of NASA's top two-man management team that lives eyeball-to-eyeball with the risks of error, Dr. Seamans expresses his candid views on this subject as follows:

"The NASA experience is far from complete, and there are assuredly many imperfections in the arts of management yet to be revealed. Several hard fundamentals, however, have been learned through trial and error or transfer from parallel undertakings.

"There is no difficulty in extracting from the dynamic and rapidly evolving program of aeronautic and space exploration a catalog of problems and, through application of hindsight, a complementary list of textbook solutions. Unfortunately, history is not repetitive. The quality of 'sameness' that permits industrial mass production, that is one of the great national strengths, is anathema to research and development.

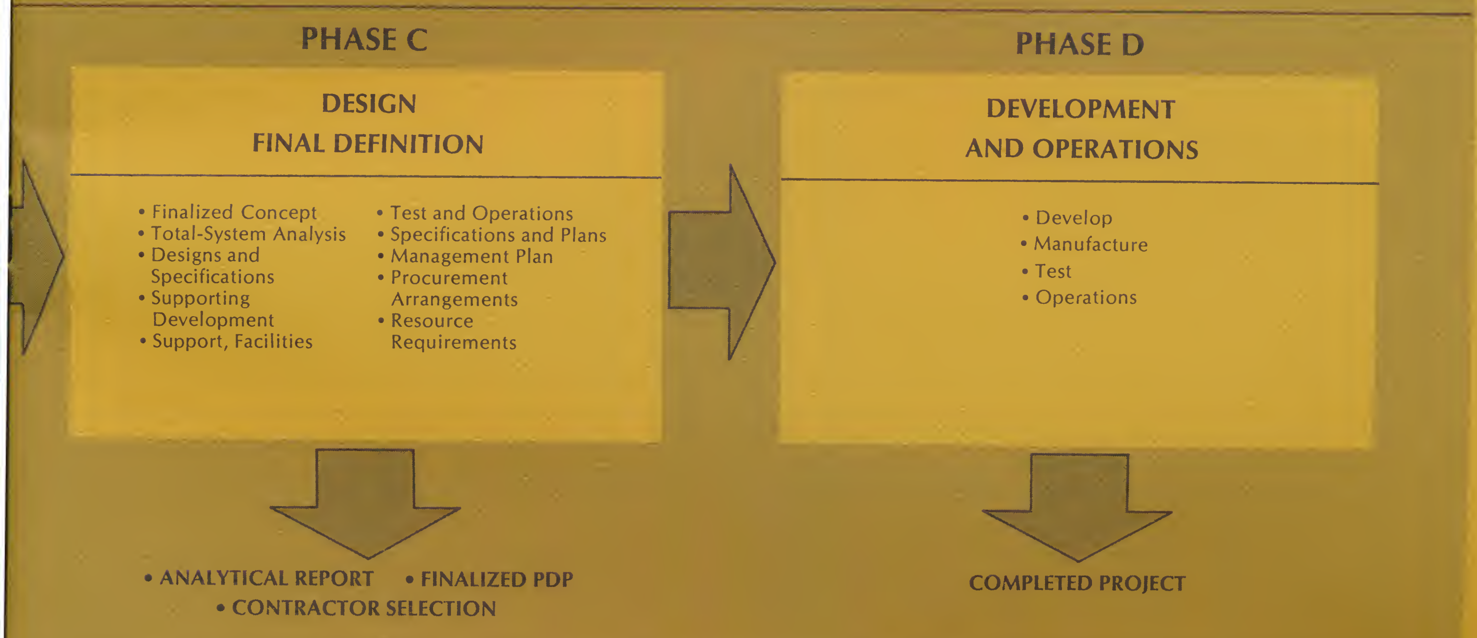
"The difficulty lies in categorizing past problems meaningfully to permit non-rote learning. Under the broad title of management discipline, the NASA problem-and-solution experience can be viewed as providing insights into planning, organization, information, and the role of people in the R&D process.

Within the framework of NASA's top-level management experience then, what lessons have been learned that can provide guidance for the management of future projects?

Here's a summary of major conclusions drawn from NASA's experience:

- Technical feasibility should be verified before commitment to a flight project. Often delays in the development of critical items will pace a large project and cause the costs to increase appreciably, or the item will fail in flight, aborting an important mission. Both a broad advanced research and development program and phased project planning are a means of early determination of feasibility.
- Design reviews must be detailed,

and must be conducted at appropriate times both prior and after commitment to flight hardware. All elements of the project team must be represented. Major changes in layout should not be made between design reviews without the approval of the project manager. In this manner the



"NASA experience is far from complete, and there are assuredly many imperfections in the arts of management yet to be revealed. Several hard fundamentals, however, have been learned through trial and error."—SEAMANS.

configuration can be made to satisfy the requirements of the experimenters, spacecraft and launch vehicle design, and ground support operations.

- Ground testing should qualify all parts and systems in a simulated "space" environment. In addition, the spacecraft should be tested as realistically as possible in environmental chambers, and launch vehicle stages should be static tested under sea-level conditions. It is also desirable to conduct dynamic tests of the entire configuration in free suspension, to determine the various bending modes.
- Mission simulation is required to train the project team and to identify difficulties in programming and procedure. In preparation for manned flights, a spacecraft simulator should be available for the astronauts. This simulator should transmit and receive information from the world network and mission control center in as realistic a manner as possible in order to train both the flight and ground crews. Experience should be obtained under nominal or expected conditions, as well as under emergency conditions where back-up modes are required.
- Modifications to existing reliable launch vehicles and spacecraft should be minimized and only made after careful design review and test. Modifications increase cost and often cause delays and even unexpected failures.
- Even when developing new launch vehicles and spacecraft such as Saturn and Apollo, it is preferable to launch the final design early. In this so-called "all-up-systems" approach, experience is gained on all components and their interaction as soon as possible. Although this approach is more subject to failure in early flights than the more conservative step-by-step approach, it is felt that there is an ultimate saving in cost and time.

Challenge and Problems

"NASA's job is to do things that have never been done before," says Jim Webb, "therefore in managerial and technical problem-solving sound judgement must often be exercised before techniques can be developed."

When he took the oath of office on February 14, 1961, Administrator Webb stated that his "purpose would be to work toward creating an environment within which NASA could be as innovative in the management of its programs as it was in aeronautics and space science." This task was assumed with a full knowledge of the awesome management challenge built-in the newly born agency: NASA was to organize itself as a going concern while managing a group of disparate space proiects conceived by other organizations and transferred in various stages of completion; secondly, NASA's level of effort and the overall size of the space program had to be increased at an incredible rate—in the first five years the program effort increased 15 times in terms of dollars, and the staff quadrupled to 32,000; and lastly the space program had to utilize technological innovation as quickly and economically as possible.

In Webb's often referred analogy, "it has been rather like removing the appendix of a big man while he was carrying a heavy trunk up three flights of stairs—without losing a step and with the stitches remaining neatly in place when he got to the top."

If by now the "trunk" has reached the third floor in good order, and the "man" is healthy and working on the

next job, the measure of success achieved by this operation is attributed by NASA's Administrator to the working relationship of the original Webb-Dryden-Seamans triumvirate. In explaining the dynamics of this relationship, Administrator Webb says: "The three of us decided together that the basis of our relationship should be an understanding that we would hammer out the hard decisions together, and that each would undertake those segments of responsibility for which he was best qualified; that with policy established, the orders for its execution could be issued by any one of us; and that, while NASA had an Administrator—as a single point of final decision—to the fullest extent possible we would act together in every major matter.

"We are continuing to build a management system that will emphasize the importance of first-class performance and individual competence at each level of organization.

"We attach high importance to the development of competence in all phases of administration as well as in the scientific and engineering disciplines, and other specialties.

"Our policy is to utilize and emphasize the importance we attach to patterns of administration that would foster a pervasive development of careful judgement as an almost instinctive approach to important problems by all key personnel."

Mechanics of Source Evaluation

As an illustration of NASA's top-level decision-making process Webb cites the mechanics of source evaluation, whereby he and Bob Seamans personally examine, in detail, the results of the work of all source evaluation boards on competitively negotiated contracts of $5 million or more.

"We expect these boards to appear before us formally, and make a full presentation of: (1) The method chosen to break down for evaluation the contractor proposals; (2) The results achieved in the application of this method and (3) The judgement of the board on each of the categories of the breakdown," explains Webb.

PROCEDURES AND AUTHORITY FOR PROCUREMENT ACTIONS

	PROJECT MGR AT FIELD CENTER	CENTER DIRECTOR AND STAFF	HEADQTRS PROGRAM OFFICE	HEADQTRS STAFF	ADMINISTRATOR
PROCUREMENT PLAN	INITIATES	REVIEWS	REVIEWS	REVIEWS	APPROVES
REQ. FOR PROPOSAL	INITIATES	REVIEWS	REVIEWS	APPROVES	
EVALUATION BY SOURCE BOARD	PARTICIPATES	PARTICIPATES	PARTICIPATES	PARTICIPATES	
SELECTION OF CONTRACTOR					MAKES SELECTION
FINAL CONTRACT	NEGOTIATES	REVIEWS	REVIEWS	APPROVES	

He further stresses that "the effect of this systematic approach to a continuous emphasis on the 'judgement factor' has been that for five years we were able to observe and evaluate how rapidly the organization and its contractors were developing their capabilities, and how effective our effort to get nine-tenths of NASA's work done by contractors was proving."

There's an additional problem that has confronted NASA's top management in the past and is likely to persist in the future. And that in Webb's words has been: "the difficulty in bringing high-level executive people in from various backgrounds and fitting them into NASA's organization; letting each serve in such a way as to derive satisfaction while serving the organization, and then either remaining or departing, depending on performance." This problem is of particular concern at the moment because it is likely to grow more serious with the delay in establishing a major post-Apollo goal.

In describing NASA's overall management structure and its management system approaches, Administrator Webb says: "They are still evolving, and for a long time they will remain anything but static.

"Our objective is to provide effective agency-wide systems in such areas as accounting, project management, and progress reporting that will be versatile enough to meet the differing needs of NASA's various elements, with activities ranging from non-directed basic research to the engineering and development of complex systems. Our aim, in brief, is to encourage useful innovation, without change just for the sake of change, complying at the same time with the requirements placed on NASA by the Bureau of the Budget and the Civil Service Commission."

Controversy of Incentive System

Assuredly one of the most controversial contracting innovations to affect the NASA—industry relationship in recent years has been the Incentive System which is currently under intensive study both within and without the government.

The criticisms leveled at the Incentive System have been that: (1) it causes delays in the contracting process, sometimes upwards of six months; (2) it tends to waste the time of engineers and scientists by extending contract negotiations; and (3) it has contributed to the worsening of government-industry relationships by causing contractual bickering.

Categoric answers to these charges come from Deputy Administrator Seamans as follows:

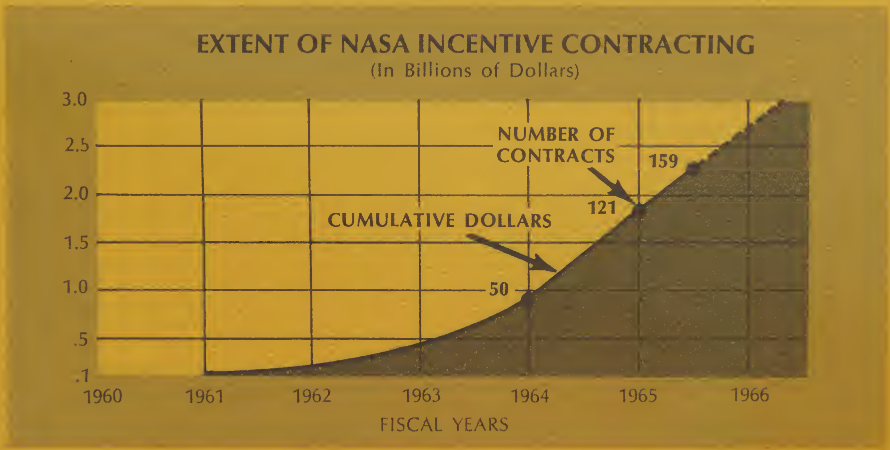
(1) "Negotiation of incentive contracts at the outset of a program generally does take longer than negotiation of cost-plus-fixed-fee (CPFF) contracts. The very nature of an incentive contract requires better definition of the nature and scope of work involved and the establishment of meaningful criteria on which the incentive arrangement will be based. This is to insure that it is structured to motivate the contractor toward optimum performance to meet the government's objectives. We feel that any delay involved is more than offset by our having a definitive arrangement which minimizes misunderstandings and the incidence of unforeseen changes during the life of the contract. Conversion of existing large and complex CPFF contracts to incentive contracts can and does require several months of intensive effort. However, during the negotiation period the contractor continues performance under the existing contract, and there is no delay in contract performance attributable to the incentive conversion effort.

(2) "The negotiation of incentive contracts for R&D work does indeed require the participation of engineers and scientists, to assure that realistic technical objectives are established and that incentive provisions are drawn in a manner which will motivate the attainment of those objectives. We believe that the application of technical effort during contract negotiations, as well as during the life of the project, is essential to the effective drafting and execution of an R&D contract.

(3) "We are not aware of a general worsening of government-industry relationships because of incentive contracts. On the contrary, our studies and evaluations of the effects of incentive contracts clearly indicate an improvement in the total contracting process. Higher management attention is directed to the contract from the outset, communications and understanding between the parties have improved, and the contracts themselves more clearly reflect the intent of the parties. While we may have differences from time to time with a contractor as to the timing of conversion from the CPFF contract to one of incentives, these differences should be considered as indicators of the complexities involved in the contract situation and not as demonstrating any deficiency in the procurement process."

Incentives for Communication

Summing up their feelings on the Incentive System, NASA's top management concedes that while the concept of incentive contracting is relatively simple, its reduction to practice is considerably more complicated. Since an R&D project is an attempt to do that which has not been done before, they agree that it often becomes difficult to establish a fair median from



which to measure the quality of performance as well as the source of responsibility for that performance. Each new project represents a whole new challenge to the administrators who are charged with organizing the procurement pattern that will support it, they say, adding that there are probably as many incentive structures as there are projects.

The fundamental lesson that both government and industry have learned, they point out, is that no meaningful incentive contract can be arrived at until very clear and precise understandings have been reached as to the objectives of the assigned task. They add that the phased project approach is an important tool in narrowing the area for misunderstandings.

NASA to Maximize Competition

NASA's mounting drive to maximize competition has highlighted, in recent years, the role of the Office of Industry Affairs, among the staff offices which report to the Office of the Administrator. The Office of Industry Affairs is headed by Assistant Administrator William B. Rieke who assumed this key position on June 2, 1965, after serving as Deputy Associate Administrator for Management in the Office of Manned Space Flight since November 1964. Prior to joining NASA, Rieke was president of Lockheed Aircraft International, as well as an officer and director of various companies affiliated with Lockheed in the international field.

"The touchstone of the NASA industry relationship is the communication system which links the Agency and the industry into a productive partnership," states Jim Webb, explaining in addition that it is Bill Rieke's general responsibility to initiate, maintain, improve, and promote communications so that the segments of the Nation's space team function together to achieve our national goals in the most economic manner."

Organizational elements reporting to the Assistant Administrator for Industry Affairs are: the Office of Procurement, the Facilities Management Office, the Labor Relations Office, the Reliability and Quality Assurance Office, and the Inventions and Contributions Board.

According to Rieke, the Office of Procurement will continue its efforts to increase the effectiveness of competition within industry by developing policy relative to the following topics currently on its docket:

- Contractor Performance Evaluation (CPE), similar to DOD's, to develop performance profiles.
- Costs of Contractors' Independent Technical Effort (CITE). NASA and DOD are currently striving to establish criteria for acceptable levels of CITE expense.
- Studies to determine reasonable levels of bidding expense.
- Delegation of contract administration for the new Defense Contract Administration Support Agency (DCASA)

William B. Rieke (right), Assistant Administrator for Industry Affairs and Administration, discusses the functions of his office with Julian Scheer (left), Assistant Administrator for Public Affairs, and David Cochran, Manager Missile & Space Field Operation, General Electric Co.

"In implementing NASA's Cost Reduction Program," says Bill Rieke, "we'll be judging contractors on how good a management job they are doing in running a 'tight ship', rather than on how successful they are as string savers."

WEBB VIEWS ON MANAGEMENT

Because of the many innovative aspects of space exploration, for which we have only the most limited experience at the very forefront of science and technology, program management has itself taken on a new dimension.

* * * * * *

The exploration of space is a great adventure. We are all privileged to be allowed to contribute. That privilege carries with it the responsibility of effective management in the national interest.

* * * * * *

A major element of the space age is its fantastic advances in the creation and control of energy . . . The knowledge, the know-how that this accurately-controlled use of vast quantities of energy gives us is national power of a far higher order than we have had in recent years.

But we are creating other kinds of power too, in the space age. We are developing the ability to organize and manage vast social enterprises on a greater scale than we have ever known. And it is imperative that we learn to do this.

* * * * * *

Only by keeping our industry and government management capability in step with our racing technology can we achieve the full benefits from our industrial base and facilities.

* * * * * *

The NASA program is, and must continue to be, a broadly-based and wide-ranging effort that improves our understanding in a wide variety of scientific, technological, operational, and management fields.

* * * * * *

. . . the trend to incentive contracting is consistent with a withdrawal of government from all but essential participation in management.

* * * * * *

The major technical advances and breakthroughs we're so proud of did not happen just because one management system rather than another was employed. We cannot even say that they were the result of exceptionally sound managerial judgement in selecting research goals and allocating scarce resources. Rather, they can be attributed to people, their skills, and the vast array of environmental influences that affect their attitudes, their personal goals, their motivation, their productivity.


ESRO
ESRANGE
KIRUNA
ESTEC
ESLAB
NOORDWIJK
REDU
DELFT
DARMSTADT
PARIS
ESDAC
SIEGE
ESRIN
Member states
Observer states

ESRO'S MONUMENTAL CHALLENGE: MANAGING INTERNATIONAL SPACE RESEARCH

Aerospace Management Staff Report

European Space Research Organization has mandate from ten parliaments to fund 8-yr. joint research and technology program for peaceful purposes

The true measure of the cooperative European space effort is not its size, but its significance, by the very precedent it sets. The budget of the European Space Research Organization (ESRO) for the first eight years (through 1970) has been limited by a financial Protocol to 1,500 million French Francs at 1962 prices (about $300 million).

The groundwork for ESRO was laid on June 14, 1962, by convention drafted by the European Preparatory Commission for Space Research (COPERS), and ESRO came into being on March 20, 1964. According to its charter, "the purpose of ESRO is to provide for and to promote collaboration among European States in space research and technology exclusively for peaceful purposes." The agreement to create ESRO was signed by Belgium, Denmark, the Federal Republic of Germany, France, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom. Parliaments of these countries subsequently ratified this agreement and all allocated contributions. Austria and Norway presently enjoy observer status.

Long-Term Commitments Made

Possibly the most significant aspect of this international venture is the fact that on a continent where fiscal frugality is a necessary attribute and where parliaments seldom make long-term monetary commitments, ten Member States have authorized expenditures over a span of eight years.

ESRO's budget for 1966 amounts to some 39 million dollars contributed by Member States on the following percentage basis:

Belgium	4.42
Denmark	2.21
Federal Republic of Germany	22.56
France	19.14
Italy	11.17
Netherlands	4.24
Spain	2.66
Sweden	5.17
Switzerland	3.43
United Kingdom	25.00

ESRO provides for the scientific agencies of the Member Countries the vehicles, launch bases and tracking facilities for the performance of space research extending from the study of ionospheric phenomena to stellar astronomy. In view of this function, ESRO characterizes itself as "a technological organization with a purely scientific purpose."

Choosing Space Experiments

Proposals are received from European scientists for space experiments that can be carried in sounding rockets or spacecraft. The proposals are evaluated by one or more of six ad hoc groups set up by the Scientific and Technological Committee (STC) of the ESRO Council. All Member States are represented on the ESRO Council. Each ad hoc group specializes in a particular field of space science: structure of the atmosphere, the ionosphere and auroral phenomena, solar studies, lunar and planetary studies, stellar systems, and cosmic radiation.

Basic task of the ad hoc groups is to assess the scientific value of the proposed experiments and to recommend to the Launching Programs Advisory Committee (LPAC) which experiments should be accepted. LPAC, in turn, takes into account questions of scientific and technical compatibility and the available technological and financial resources, then recommends to the STC complete payloads composed of several experiments. The Administrative and Financial Committee (AFC) takes account of these recommendations in its financial and administrative recommendations. Payload recommendations made by the LPAC are reviewed by the STC, which then prepares a launching program for consideration by the ESRO Council. It's the Council's function to approve the launching program and to develop an internal program of technological research.

Progress in Spite of Barriers

During a lecture given in Dusseldorf, Germany, last year, Professor Giusseppe Gabrielli of the FIAT Corporation probably gave the best summation of a European handicap which makes the task of a widely dispersed organization like ESRO especially arduous. In Prof. Gabrielli's words: "Old Europe is an inexhaustible source of ideas, but the men involved fight against the lack of means and the great dispersion of the resources available."

In a geographical sense, the "dispersion of resources" in Europe is no greater than in the United States. But the fact that resources and facilities are located behind international boundaries — with attendant diplomatic, cultural and communication barriers —makes the progress achieved to-date by ESRO especially significant.

ESRO Has Own "Alphabet Soup"

If there is a great similarity between the European and the American space programs, it is in the abundance of acronyms that by necessity populate both programs. Here then, at a glance, are the widespread facilities of ESRO identified by acronyms:

ESDAC: European Space Data Center, Darmstadt, Germany.

ESLAB: European Space Research Laboratory, Noordwijk, Netherlands.

ESRANGE: European Space Range for sounding rockets, Kiruna, Sweden, to become operational by the end of 1966.

ESRIN: European Space Research Institute, Frascati, Italy.

ESTEC: European Space Technology Center, Noordwijk and Delft, Netherlands.

ESTRACK: European Space Tracking and telemetry network is in an advanced stage of development. Telemetry station locations are Fairbanks, Alaska; Spitsbergen, Norway; and Port Stanley, Falkland Islands. A fourth station at Redu, in

the Belgian Ardennes, will have both telemetry and tracking facilities.

By far the largest establishment of ESRO is ESTEC which comprises three Departments:

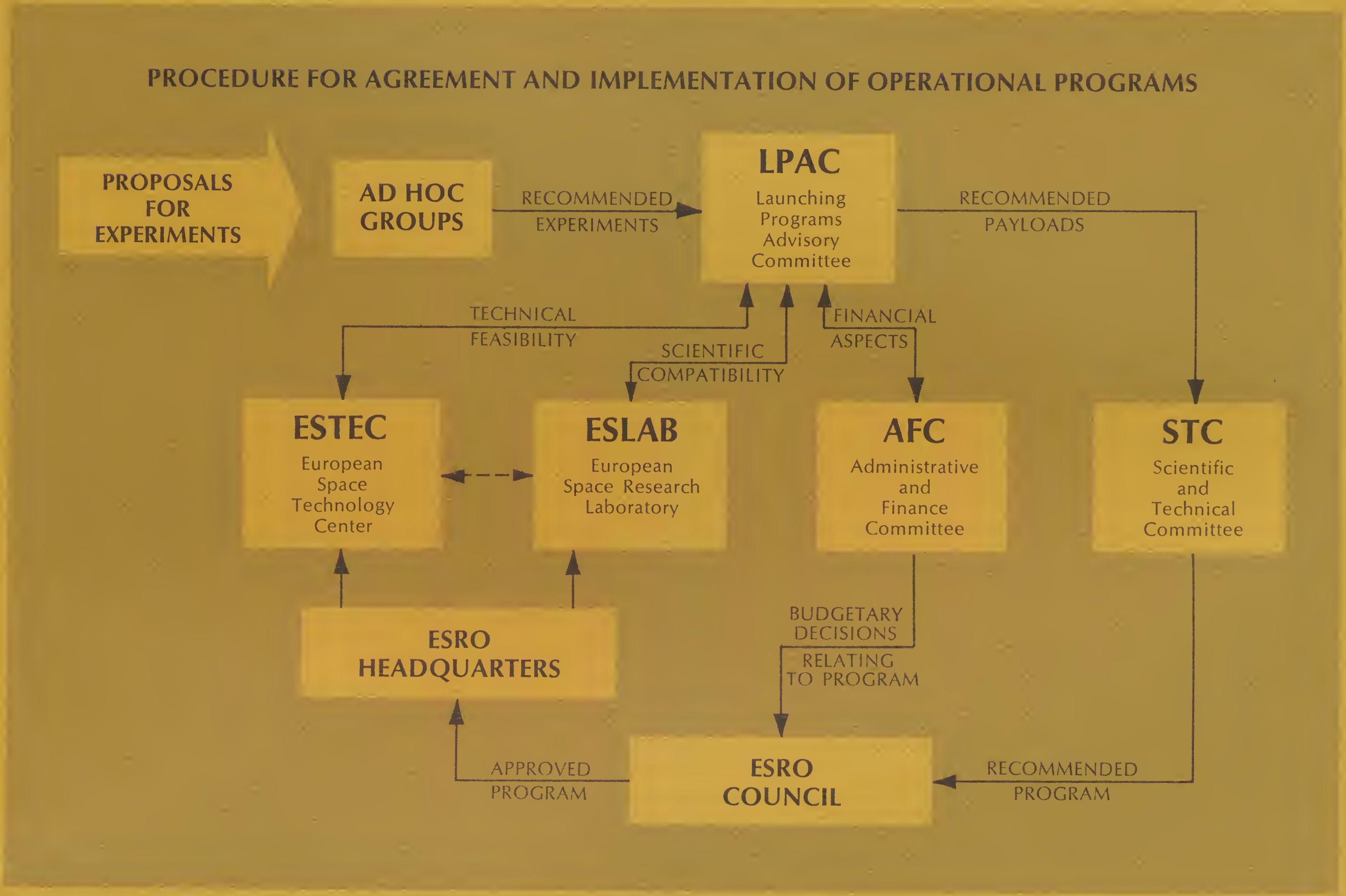
Sounding Rocket Projects Dept. is responsible for the design and development of payloads, and for the launching of sounding probes from ESRANGE as well as from various national ranges.

Spacecraft Projects Dept. is charged with the design and development of all satellites. These include the small satellites ESRO 1 and 2, the highly eccentric orbit satellites HEOS-A, the medium satellites TD-1 and TD-2, and the Large Astronomical Satellite (see the accompanying satellite program chart). This Department also includes the Control Center, which will direct the satellite tracking and telemetry network of ESTRACK stations.

Applied Research Dept. conducts research in the basic technology associated with future project requirements, and assists the above two Departments in research and development work. Five Divisions within this Department perform specialized work in such areas as environmental testing, instrumentation, power supplies, control and stabilization, and dynamic analysis.

ESRO's Channels of Communication

In the implementation of ESRO's launch program, ESTEC performs the technological tasks and ESLAB the scientific functions, including those related to the Large Astronomical Sat-



ellite. ESLAB is also charged with the job of maintaining liaison with ESTEC and with the University groups participating in space research. There are provisions for certain visiting scientists from the Member States to have facilities at ESLAB for undertaking work on space experiments.

The task of processing and analyzing data from satellite and sounding rockets is assigned to ESDAC which will in addition undertake studies in celestial mechanics and orbit computation.

Operative since the beginning of this year, the newly organized ESRIN will soon be complementing the work of other ESRO establishments by providing experts in the fields of theoretical and experimental physics and chemistry, as related to space sciences. ESRIN activity will center primarily on laboratory simulation experiments.

Lastly, from its headquarters in Paris, ESRO provides basic administrative and secretariat services, and performs such centralized functions as technical and scientific planning, public relations, and documentation.

The ESRO Secretariat plays a key role by serving as a focal communications group between the dispersed centers of activity. It is the Secretariat's function to coordinate record and disseminate all major decisions, as well as to organize the yearly science school programs offered for the benefit of ESRO staff members. In addition, the Secretariat maintains ESRO's microfiche documentation file and exchanges computerized documentation data with the National Aeronautics and Space Administration.

SUMMARY OF CURRENT ESRO SATELLITE PROGRAM

DESIGNATION	LAUNCH VEHICLE	LAUNCH DATE	WEIGHT	MISSION	CONTRACT STATUS
ESRO 2	NASA Scout	March 1967	190 lb. Payload	Study of inner Van Allen belt, solar X-rays and UV radiation	Prime contract to Hawker-Siddeley, UK
ESRO 1	NASA Scout	Sept. 1967	176 lb. Payload	Collection of ionospheric and particle data over North Pole	Prime contract to L.C.T. France
HEOS A	Improved Delta	Oct. 1968	226 lb. Total	High Eccentric Orbiting Satellite to gather interplanetary particle data and map Earth's magnetosphere	Prime contract to Junkers, F.R.G.
TD-1, TD-2	Thor-Delta	1968-1972	440-880 lb. Total	Study of stellar and solar astronomy, X-ray and gamma radiation	Prime contract award estimated Fall 1966
LAS	ELDO-A or Atlas-Agena	1970-1971	1800 lb. Total	Large Astronomical Satellite to place 31.5-in. diam. telescopes in 300-mi. circular orbit	Tender estimated to be released Summer 1966; Prime contract award estimated Spring 1967

ESRANGE complex in Kiruna, Sweden will be operational by end of 1966.

ESRO Plans and Programs

During the first decade of its operations, which extends to 1972, ESRO efforts will center on building a major space exploration capability, next in rank to those of the U.S. and the U.S.S.R. The ESRO launch program for this period includes some 400 sounding rockets, seven space probes, six small unstabilized satellites, eight medium-weight satellites, and two large payloads. The sounding rocket efforts of ESRO are planned to avoid duplicating those of the U.S. and are aimed primarily at auroral phenomena, solar studies, micrometeoroid counts, and cosmic ray and solar plasma measurements in the E and F layers of the ionosphere.

All sounding rocket payloads used thus far have been designed and built by ESTEC, but about 50% of the future work will be contracted to European industry, according to ESRO officials.

The mainstay vehicles of the sounding rocket program have been the British Skylark which can boost 245 lb. to 135 mi.; the French Centaure and Dragon, which can lift 65 lb. to 115 mi. and 110 lb. to 373 mi., respectively; and five U.S. Arcas rockets which were fired from Greece during the solar eclipse in May, 1966.

Until recently, ESTEC has used the Italian missile range in Sardinia as its temporary site. When the permanent site in Kiruna, Sweden, becomes operative in August 1966, it will be used for launching over half of ESTEC's sounding rockets.

Spadework for Cooperation

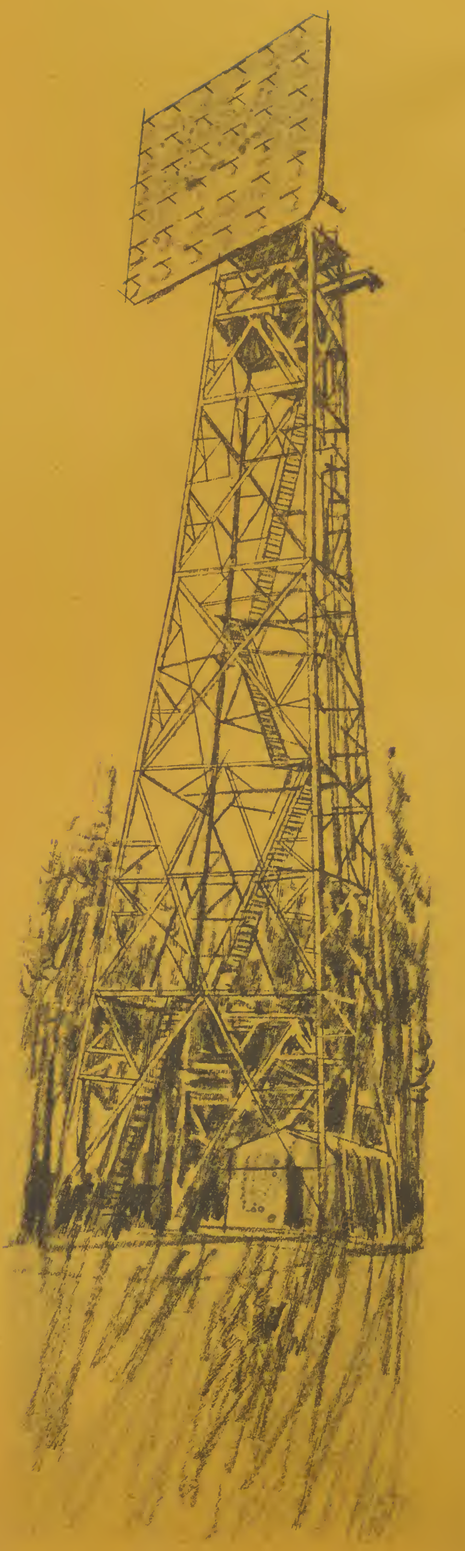
In March this year, ESRO quietly completed its second year of operations. Conditioned as it has become to U.S. and U.S.S.R. space spectaculars, the world hardly took notice of this milestone in the youthful life of ESRO. Although unspectacular against a backdrop of lunar payload landings and manned exploits, ESRO's progress to-date has clearly achieved a new dimension perhaps in the most wanting field of human activity—international cooperation. In the first two years then, the foundations for this new type of cooperative effort have been laid. And by the start of the next decade Europe through ESRO should be in a position to make substantial contributions in space science.

Meanwhile, a monumental challenge lies ahead for Europe—the overall coordination of effort related to space research. But unlike NASA, in its present concept ESRO is not vested with such a mandate. For the original agreement for cooperation stated that the service provided by ESRO was not to be in competition with the national organization of the Member States.

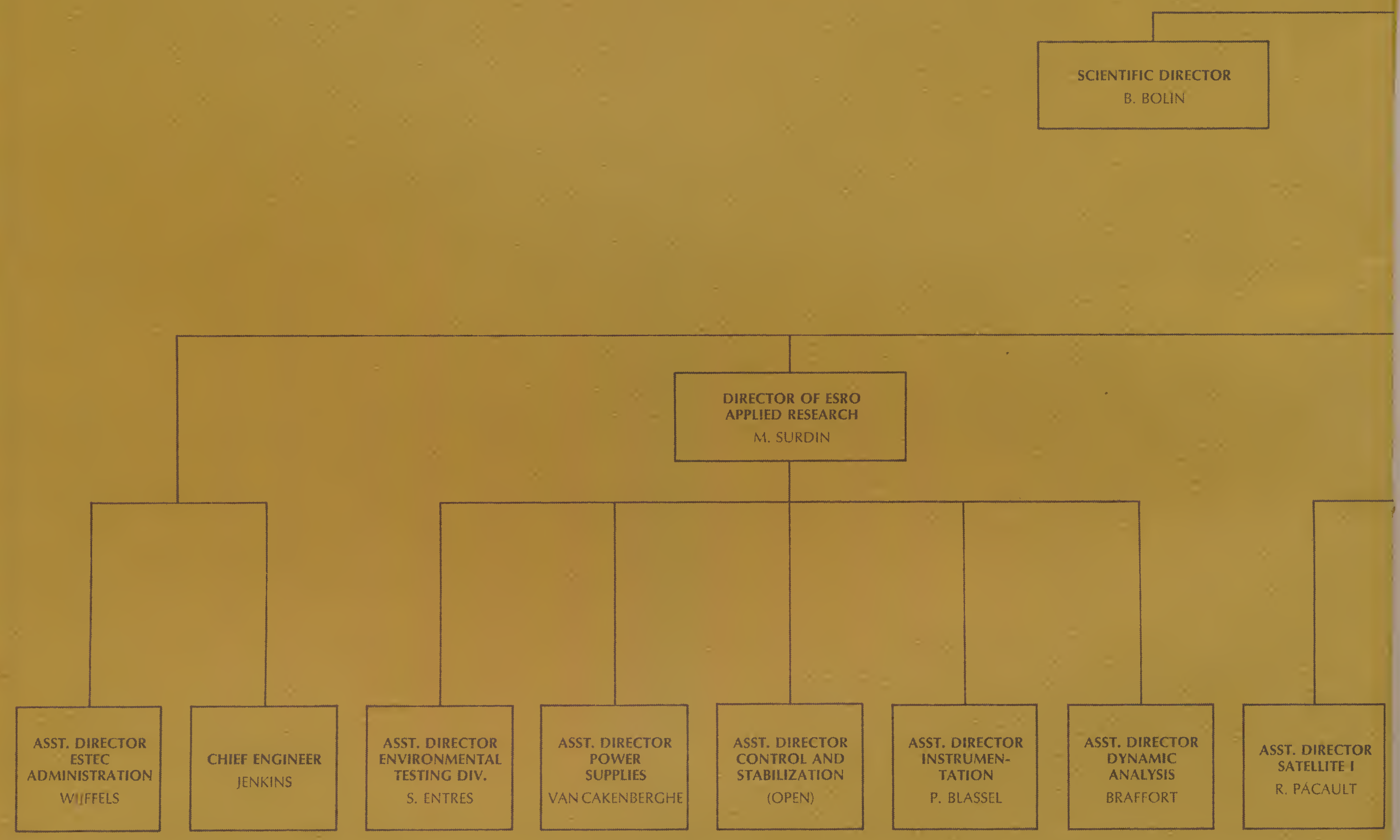
There are indeed spokesmen of the European aerospace industry who have proposed a "European NASA" with a broad enough mandate for overall coordination of efforts. But presently this is considered as an indelicate subject by others who maintain that ESRO must first have the opportunity to prove itself under its existing charter.

There seems, for the moment at least, considerable reluctance by ESRO to embark on extensive and expensive joint projects with the United States, such as the proposed Jupiter probe or the solar fly-by mission. If this reluctance is based to a great extent on the limitation of resources, it may spring, in part, from a strong desire to first establish a European identity in space research. This is the epoch of European self-realization. And the "Old World's" aspirations regarding space are yet another expression of the will to shape its own destiny.

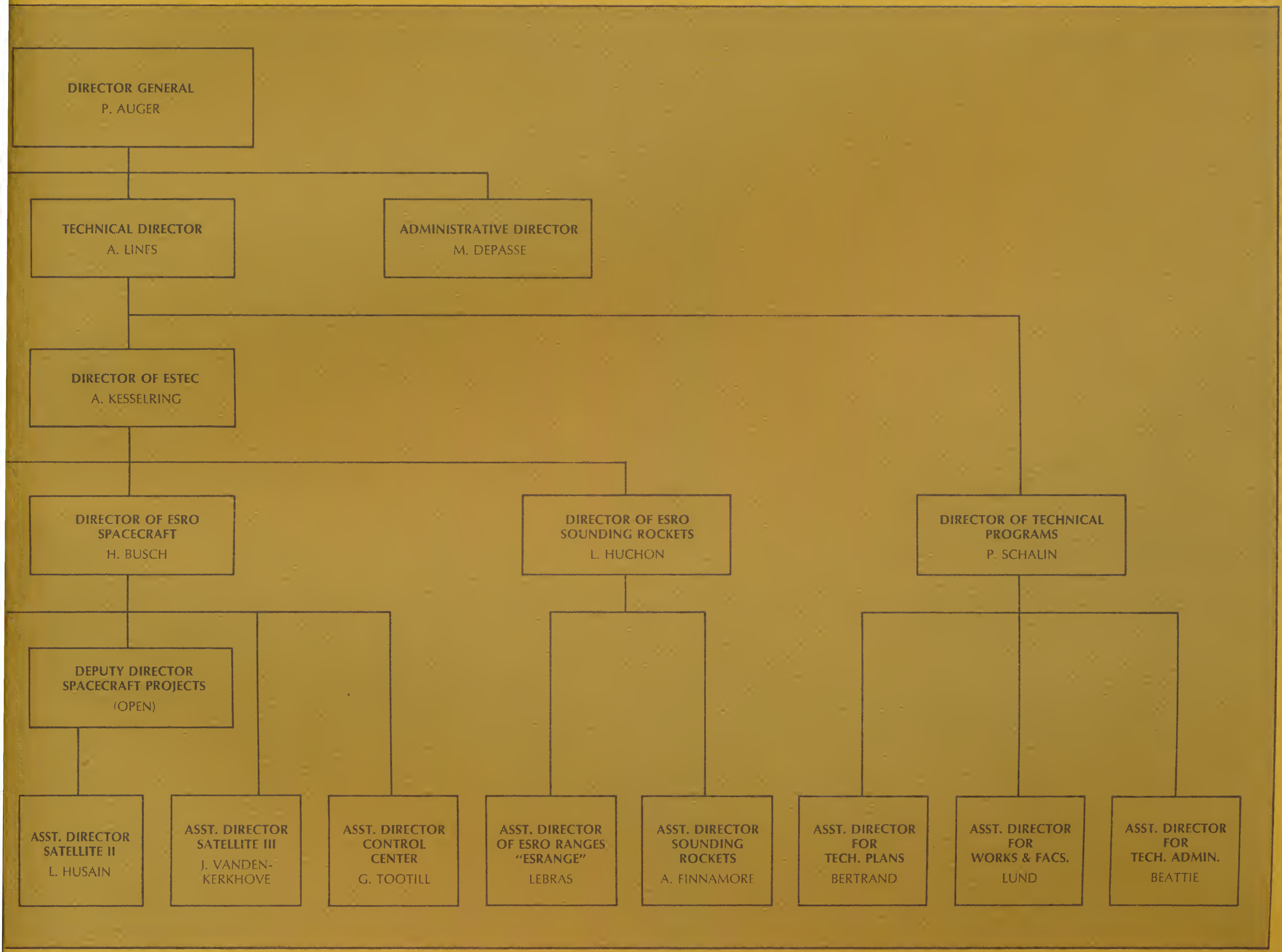
As he faces a multitude of more mundane problems, the European-in-the-street today may find it difficult to justify the expenditure of vast sums for space research. As the burden of space research grows together with its promise, men-in-the-street everywhere may well recognize the need to cooperate on a true international scale. They may realize then that ESRO has already done much of the spadework.



EUROPEAN SPACE RESEARCH ORGANIZATION



ESRO headquarters located at 36, rue La Perouse, Paris 16, occupy historic Majestic Hotel.




AF INSTITUTE OF TECHNOLOGY

HOW THE AIR FORCE FORGES MANAGEMENT LEADERSHIP

By S. Peter Kaprielyan

DOD's drive for broad-gage project leadership is in full swing; Air Force has key role to train managerial talent on four levels

In the conditions of modern life the rule is absolute, the race which does not value trained intelligence is doomed. Not all your heroism, not all your social charm, not all your wit, not all your victories on land or at sea, can move the finger of fate. To-day we maintain ourselves. To-morrow science will have moved forward yet one more step, and there will be no appeal from the judgement which will then be pronounced on the uneducated.

Alfred North Whitehead (1916)

In the turbulent scientific-technological climate of this decade, where complex and costly systems grow, managerial talent is a prize commodity. No one has been more aware of this than the Air Force, who as chief innovator and user of such systems, has also been busy training its new generation of project* managers.

Traditionally, opportunities for economic growth have made the United States a fertile ground for the cultivation of managerial talent. But up to the mid-point of this century, managerial mastery had developed mostly along two dimensions: The conduct of vast complexes of business enterprise, and the pioneering of methods in mass production and distribution. And to cope with the educational requirements of the day, academic institutions had their curricula accordingly oriented.

The birth of aerospace systems and weaponry, in the last decade, began to affect profoundly the established ways of doing business with the government: The government has since been spending more for buying less; system complexity has been scaling orders of magnitude, while lead time for breeding and fielding these systems have been shrinking; networks of subcontract activity are stretching across the nation, yet the responsibility for control is being focused sharply on prime contractors; and the cost-plus-fixed-fee mode of contracting is fast being replaced by incentive-type contracting — to improve marksmanship in costing, delivery and technical performance. During the last few years, these paradoxes have raised waves of reappraisals regarding the philosophy and mechanics of management operating in industry and government.

Possibly the most significant realization to result from these appraisals was that of the urgent need to broaden the vision of decision-makers on all levels. In some cases, the problem was to overcome managerial myopia developed through long use of traditional techniques; in other instances, correction was needed of managerial tunnel vision acquired through extreme scientific specialization.

Overview Replaces Parochialism

Having played a leading part in ushering in the era of complex weapon systems, the Air Force was among the first organizations to also face the new management challenge.

The systems concept was developed shortly after World War II, when first efforts were made by the Air Force to marry the systems concept with weapons development and acquisition. But true to human nature, the adoption of this new concept was slow in gaining acceptance. As an interim measure, a joint Weapon System Project Office (WSPO) was established to manage new hardware programs from a systems point of view. Finally, a major reorganization of the Air Force took place in 1961 and gave birth to the Systems Command.

A focal reason for the reorganization was the recognition that the phases in weapon systems acquisition could no longer be considered separately—that in the future, R&D, production, training, operation, and multi-service use of weapon systems needed to be considered, planned, and implemented as closely-related elements for economy and efficiency. It thus became apparent that the Air Force needed to launch an educational campaign to raise the sights of its new system/program managers from the "parochial" level of a project officer to the vantage point of the overview of a System/Program Director. Accordingly, Gen. Bernard Schriever, Commander of the Air Force Systems Command, in February 1962 directed the establishment of a System/Program Management Course for developing a cadre of potential System/Program Directors with the new

*System/project terminology is established in DOD Directive 5010.14, and is used to define the management concept for a designated system/project within DOD. The Air Force terminology of system/program management is used synonymously with the DOD term.

outlook. The task of training the Systems Command's future system/program managers was delegated to the Air Force Institute of Technology (AFIT), and accomplished by contract with the Ohio State University.

Since its inception in September 1963, the 12-week System/Program Management Course (570) has graduated over 350 students who have subsequently been assigned to system/program activities. Candidates have been nominated primarily by Division commanders, based on high Officer Effectiveness Ratings. Originally, candidates were selected from senior grade officers; more recently, students have been chosen also from the lower ranks. Civil Service aspirants have been required to have a rating of GS-13 or higher.

With few exceptions, candidates have had some System Program Office experience. Although an academic background has not been a requisite for candidacy, all applicants thus far have held Bachelor's degrees or better.

"The SPO 570 course draws its strength and timeliness from the vast storehouse of Systems Management know-how that exists both in the Air Force and the Aerospace Industry," says Lt. Col. M. L. Kuzma heading the faculty of the SPO "school". His guest lecturers' list includes an impressive array of speakers from HQ USAF, HQ

AFSC, systems product divisions and the industry. Colonel Kuzma stresses that the instructional techniques used in the course are completely student centered—with special effort to encourage student participation in free discussions on presented subject matter. The methods used include lecture/discussions, simulation, panel discussions, case studies and individual student presentations to stimulate cross fertilization. To promote group effort, each class is divided into teams of four that select a research report topic on a current need or problem related to systems acquisition or program management. Upon graduation, most of the students return to the SPO's from which they came, and strive to work their way to the top as program directors.

Although the SPO course is primarily oriented toward Air Force needs, based on the availability of space, students have been accepted also from NASA, the industry, as well as from allied armed forces.

SPO Indoctrination Course

"This particular course was born as a direct result of the recognition of a need by a SPO 570 class," states Norbert Kidd of the Directorate of Systems Policy, Air Force Systems Command (AFSC). The point brought up in this case was that in addition to course 570, aimed at the program management level, a less intensive course for supporting personnel could be equally beneficial for the "grass roots" level in System Program Offices. The point was well taken, and the SPO Indoctrination Course was authorized in November 1964 by AFSC Regulations 50-2.

As suggested by its name, Course 50-2 is provided at the Systems Division level solely for indoctrinating personnel newly assigned to System Program Offices. It includes two weeks of full-time classroom instruction on the terms, methods, policies, procedures, and publications bearing on system/program management — with stress on scope of authority and responsibility of SPO personnel. For maximum effectiveness, subject matter is tailored to the specific product requirement of each Systems Division.

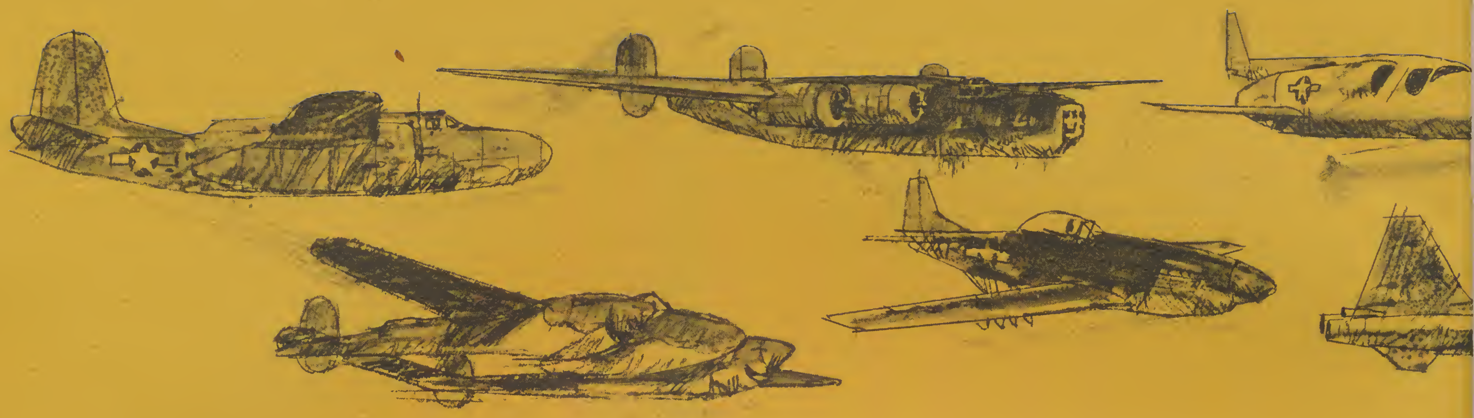
Instructors for this course normally include members of the Division staff who are functional specialists, graduates of SPO 570, System Program Directors, and colocated representatives of participating commands.

As Norb Kidd sees it: "Course 50-2 is paying off immediate returns by boosting the effectiveness of newly-assigned personnel and orienting junior officers who aspire to fill, some day, the boots of a SPO director."

Graduate Management Course

By October 1962, while the first students of the SPO 570 class were getting their bearings at AFIT, HQ USAF was casting the foundations of a 15-month Graduate Systems Management course leading to a Master's degree. Action to initiate this program was triggered by Gen. Schriever during the previous year. While weighing the long-range manpower needs of the Air Force—in view of reorganization and increasing space mission — the commander of AFSC had foreseen a serious shortage of R&D officers by 1970. Accordingly, Gen. Schriever had asked the Aerospace Systems Division of AFSC for a plan of action "to develop a command position on the establishment of a Program Manager's Course at AFIT . . . to better equip AFSC officers as System/Program Directors. . . . Additional prime objectives of such an educational program (being) relief of the young officer retention problem, filling the retirement gap, and the attraction of 'new blood'."

The Graduate Systems Management (GSM) program has been in effect since September 1963, with rigorous candidacy requirements: Grades, Captain through Colonel—with primary emphasis on officers having seven to fifteen years active commissioned service, and demonstrated potential



as System Program Director.

"While the objective of the SPO 570 course is to develop the students' grasp of the total environment in which systems acquisition takes place —with accent on organization, mission and functions," explains Col. W. W. Converse who heads the Systems Management faculty in AFIT's School of Engineering, "the Graduate Systems Management program stresses the scientific approach to decision-making, seasoned by heavy doses of academic theory and philosophy of management."

Purpose of the GSM program is to educate and train officers as well as senior grade Civil Service personnel for assignment to AFSC as Systems Managers. But the systems development and acquisition medium in which SPO's exercise their prerogatives is perpetually beset by changing needs that can affect the effectiveness and timeliness of the GSM program. To keep the program zeroed-in on AFSC's changing needs, AFIT requests each graduate to complete and return a feedback questionnaire at six, twelve and eighteen months after graduation. By this follow up, AFIT strives to determine: To what extent the GSM program has prepared the individual to the responsibilities of his position or assignment? What changes in the curriculum, course plan or presentation techniques would the alumnus recommend? What additional changes would he suggest in specific subject courses?

The summaries of gathered recommendations are presented for consideration to the biannual meetings of the AFSC/AFIT Educational Council.

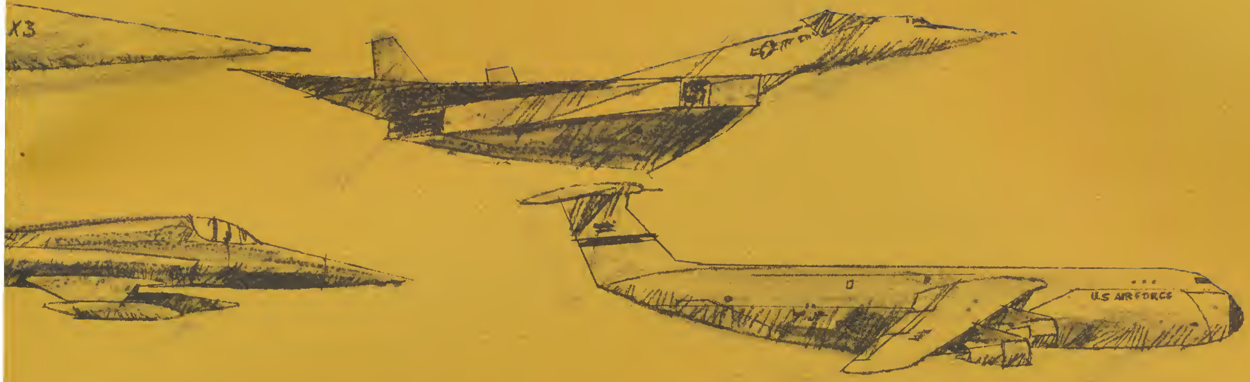
DWSMC Provides Overview

The three types of educational programs discussed thus far have a distinct relationship: they are all oriented to Air Force needs, and together they provide a full spectrum of training in system/project management. But DOD's task in orienting project leaders to the philosophy of complex systems acquisition extended beyond a single department, in that the Army and the Navy were also confronted with the same type of management challenge. In view of this, by April 1963 top-level thinking at DOD was turning toward a training program with a broader objective: to familiarize personnel assuming positions of responsibility in central offices, with the basic philosophy, methods and practices of weapon system acquisition common to all military departments.

The concept for a training program with this objective finally crystallized at the DOD Conference on Program Management, held in April 1963 at New London, Conn. Following the conference, leadership for organizing a Defense Weapons System Management Center (DWSMC) was assumed by Assistant Secretary of Defense, James N. Davis; and the task of establishing and operating the Center was later assigned to the Air Force.

DWSMC has been functioning at Wright-Patterson AFB since September 1964 under the leadership of an interservice triumvirate: Commandant Col. John F. Harris, USAF, and Assistant Commandants, Col. James H. Schofield, Jr., USA, and Capt. Kenneth W. Heising, USN.

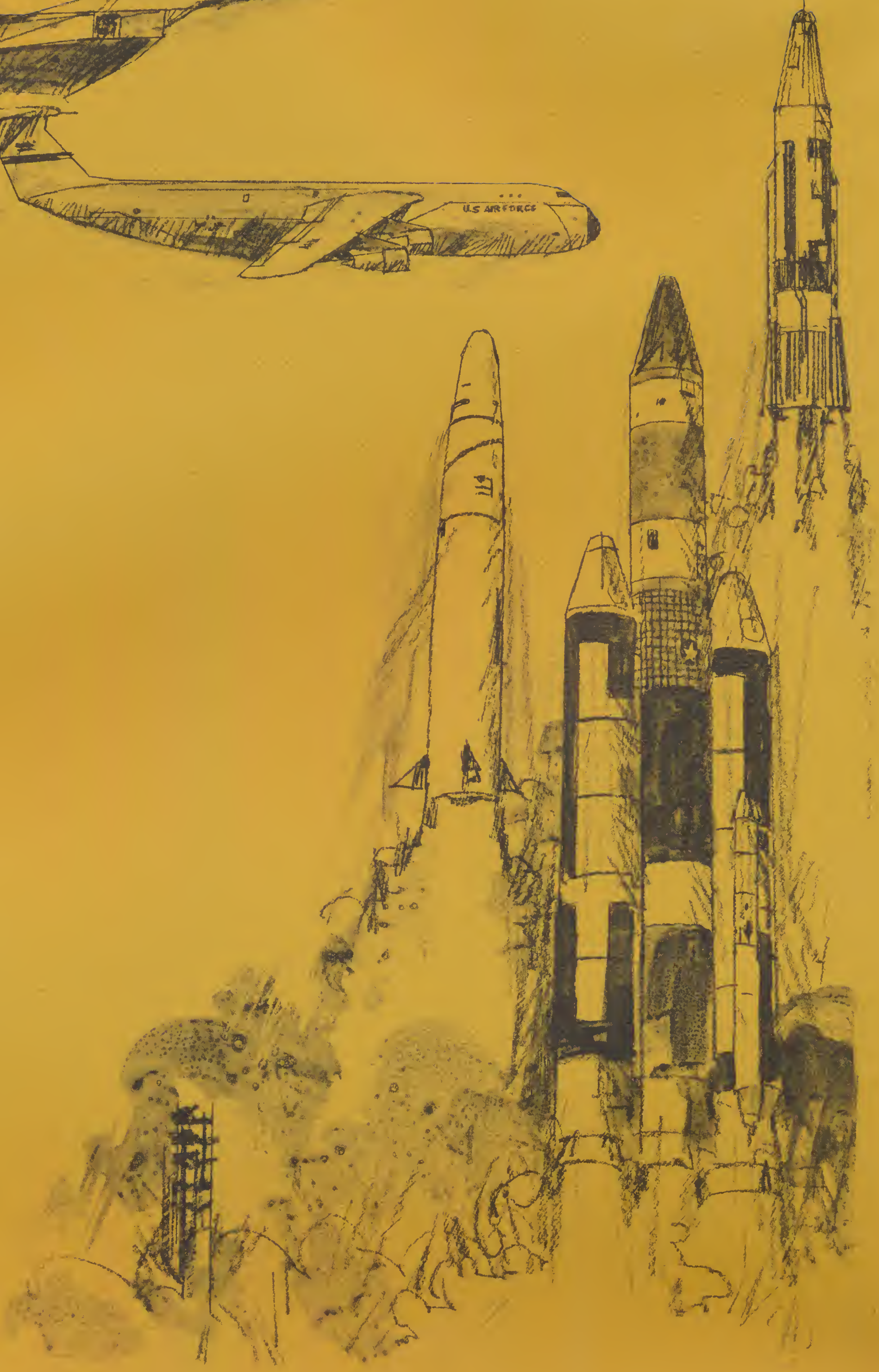
Although DWSMC is operated by the Air Force, the Center's prime objective is to serve the needs of all military departments. To this end, the



Center offers a 12-week curriculum each quarter, with subject matter patterned around the system life-cycle approach—in the order in which a system/project manager would be most likely to encounter.

Continued research and identification of weapon systems management concepts, doctrine and techniques are now considered a vital part of the program. Entrance qualifications are a grade of Lt. Colonel/Commander, or GS-14 and higher, plus a college degree or its equivalent. Students must be currently assigned or have a projected assignment at the senior level in management of a major system/project.

Guiding policy from the office of the Secretary of Defense comes to the Center through the Director of Defense Research and Engineering (DDR&E). Although the DWSMC curriculum is primarily for DOD personnel, when space is available students are accepted also from industry. Nominations for industry participation are processed by the Council of Defense and Space Industry Associations (CODSIA), located at 1725 De Sales Street, N.W., Washington, D.C. 20036.



The sprawling complex of runways, hangars, test facilities and administration buildings now known as Wright-Patterson Air Force Base has played a dominant role in building the sinews of airpower for over half-a-century. From the fledgling days of powered flight, to the adulthood of aviation through World War II, this center has traditionally supplied the technical brawn of the Air Force. For the past two decades the Air Force Institute of Technology, heir to the educational activities of an emancipated Air Force, has been actively engaged in building another tradition: raising brainpower for a new breed of leadership that must be deft in melding technical knowledge with managerial acumen. The growing importance of training and education to the Air Force can be appraised from the assignment, in April 1950, of command jurisdiction of the Air Force Institute of Technology, to the Air University which now enjoys the status of a major command.

Under the guidance of Secretary McNamara, one of the more recent tasks of the DOD has been to assure that the new system/project leadership derives its strength from rigorous intellectual training. By its early recognition of the need for intellectual training, the Air Force has led the way in meeting the management challenges of the weapon system environment.

DOD's drive to enlighten leadership in system/project management is now gaining momentum. And with regard to the future, it may be appropriate here to paraphrase from the leading quotation by Alfred North Whitehead: "To-morrow science will have moved forward yet one more step, and there will be no appeal from the judgement which will then be pronounced on . . ." organizations that have been lax in motivating and supporting the intellectual development of their own decision-makers.

SYSTEMS MANAGEMENT TRAINING OPPORTUNITIES

COURSE	LENGTH	PURPOSE	QUALIFICATIONS
SPO Indoctrination Course commonly called 50-2 after its authorizing Air Force Systems Command Regulation	2 weeks	To acquaint newly assigned personnel to SPOs with the systems management terms, methodology, procedures, publications, and policy	New assignment in a SPO or to a primary support activity
System Program Management Course, referred to as SPO course, or 570 after its Air Force Institute of Technology course number	12 weeks	To prepare SPO personnel for greater responsibilities leading to SPO Director	Captain to Lt. Colonel or GS-13 and higher. Assigned to a key position in a SPO, or in direct support thereof. Six months' experience min. High rating index
DWSMC Course offered by the Defense Weapons Systems Management Center	12 weeks	To fulfill the training needs oriented to major weapons systems management for all DOD components	Lt. Colonel and Colonel, or GS-14 and higher, assigned to or have anticipated assignment to top level SPO position or in direct support thereof
Graduate Systems Management Program, abbreviated as GSM (MS degree conferred)	15 months	To develop potential SPO s management skills, attract new talent to AFSC, and to assist in developing careers for young officers	Captain to Lt. Colonel, with degree in science or engineering

AIR FORCE INSTITUTE OF TECHNOLOGY SCHOOL OF SYSTEMS AND LOGISTICS

System Program Management Course (570)

Summary Outline of Curriculum

Executive Branch of Government in Systems Acquisition

Role of the DDR&E in Systems Acquisition

Role of the Asst. Secy. (I&L) in Systems Acquisition

Hitch Package Concept in Defense Planning, Programming and Budgeting

Air Force Organization, Plans, Programs and Policies in Systems Acquisition

Foreign Technology Division and Soviet Organization

Personnel and Manpower

Research Paper Briefing and Selection

Research and Technology Division Plans, Programs, and Responsibilities in Systems Acquisition

System Program Office Concept

Organization and Responsibilities of the SPO/SPD

System Life Cycle

Systems Program Management Exercise "Organizing/and Manning of the SPO"

SPO Man Critique

Legislative Liaison

Defense Documentation Center

AFSC Management Information System

Role of Not-For-Profit Organizations

Personnel Subsystem

Aerospace Industries Association of America (AIA)

Management Control in the SPO

National Aeronautics and Space Administration (NASA)

Systems Acquisition in the Army

Inter-Intra System Integration

Air Training Command Functions and Responsibilities in Systems Acquisition

Role and Responsibilities of the Strategic Air Command in Systems Acquisition

Systems Engineering and Analysis

Principles of System Engineering Management

Configuration Management

Systems Management in Industry

Program Resources and Objectives Management (PROM)

Software Acquisition, Techniques and Problems

System Safety Engineering

Systems Acquisition in the Navy

System Package Program

Management of Systems Aerospace Ground Equipment

Cost Estimation and Analysis

Transportation and Packaging

SPO Procurement and Production Responsibilities

Policy Aspects of Procurement/Production

Practical Aspects of Procurement/Production

Procurement Considerations and Actions Prior to Contract Award

Quality Control and Value Engineering

SPO/CMR/AFPRO Functions, Responsibilities and Relationships in Systems Acquisition

Source Analysis and Selection

Contracting

SPO-MAN-X Source Selection

SPO-MAN-X Critique

Incentive Contracting

Air Force Calibration Program

System Program Director/System Support Manager

Reliability and Maintainability

Management of Systems Data

Advanced Planning and Program Decision Making

Program Budget Control and Analysis

Systems Management

Contracting Officers and Contract Administration

Principles and Techniques of Negotiation

System Testing and Deployment

Military Facilities Construction

Fundamentals of Data Processing Systems

Supply and Maintenance

PERT

AEROSPACE MANAGEMENT
GENERAL ELECTRIC COMPANY □ MISSILE AND SPACE DIVISION